MPHIL IN HEALTH SCIENCES EDUCATION THESIS

TITLE

The use of automated integrated management of childhood illness guidelines in primary health care in the Western Cape of South Africa

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Declaration

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December 2012

Abstract

Introduction

Under-5 year mortality in South Africa is increasing and effectiveness of primary care is a key factor. Adherence to IMCI guidelines by primary care nurses is critical. The IMCI guidelines provide a standardized integrated approach to delivering quality care. Nurses in South Africa are currently using a paper-based guideline. The automated guideline in the format of a convertible personalised computer tablet aimed to improve training in IMCI and the quality of clinical decision making. The automated guideline was designed to systematically guide the nurse through the algorithms thus reducing errors and making care more effective. This study evaluated the use of automated guidelines in improving the training of nurses.

Methods

A sample size of thirty Professional Registered Nurses (PNs) was selected from the one year Postgraduate Diploma in Clinical Nursing Science at Stellenbosch University. Observational study design compared 15 PNs who used and 15 who did not use the automated guidelines during training. Nurses were compared in terms of their knowledge of IMCI after classroom based teaching and adherence to IMCI in clinical training practices.

Results

Both groups improved their knowledge of IMCI, but were not significantly different at the end of the classroom teaching. Nurses in the automated group showed significant improvement in their clinical practice ($p<0.05$): gathering information on HIV risk (50% vs. 93%) or immunisations (68% vs. 93%); making a complete assessment of the patient (61% vs. 100%), prescribing correct medication (50% vs. 85%), correct dose (42% vs. 85%) and safety netting (78% vs. 96%).

Conclusion

The use of automated guidelines showed potential for improving adherence to IMCI in the Western Cape. Further research is needed to determine if the widespread use of the automated version by PNs translates into better quality of care and improved health outcomes.

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The use of automated Integrated Management of Childhood Illness Guidelines in Primary Health Care in the Western Cape of South Africa.

1. Introduction

"Every year almost 10 million children die before reaching the age of five despite the fact that two-thirds of these deaths could be prevented by effective low-cost interventions" (Black, 2003). Although there has been a 35 percent decline in the global under-five mortality rate between 1990 and 2010 the rate is still unacceptably high at 60 deaths per 1000 live births (Inter-agency group of child mortality, 2011). About half of under-five deaths occur in only 5 countries: India, Pakistan, China, Nigeria and Democratic Republic of Congo (Inter-agency group of child mortality, 2011).

In 2009 Africa accounted for 52% of under-five mortality (Inter-agency group of child mortality estimation 2011). The global burden of disease from under-five deaths is increasingly concentrated in Sub-Saharan Africa, where the rate is more than 17 times the average for high income countries (Ijumba 2003). The Millennium Development Goal is for 20 deaths per 1000 live births in 2015 (Inter-agency group of child mortality, 2011). High income countries are on course to meet the Millennium Development Goals (MDG), with a reduction of 3.8 percent annually in mortality rates. However these countries only share 1.3 percent of the global under-five deaths compared to low and middle income countries. Although Africa continues to show some progress in reducing the under-five mortality rate, more needs to be done to reach the MDG. Only a few years remain to achieve the MDGs by 2015.

In 2000 SA adopted the MDGs and committed to reduce the child mortality by two-thirds by 2015 (Ijumba, Day C, Ntuli 2003). South Africa (SA) is classified as a

middle-income country and spends 8.5% of its Gross Domestic Product on health care (Department of Health, 1997). According to the World Health Organisation and the World Bank, South Africa's expenditure on health care is higher than similar countries such as Malaysia 3.8%, Brazil 7.6%, Tunisia 5.4%, Thailand 3.3%, Iran 6.5%, Cuba 7.3% and Nigeria 5.0% (Hugo, Allan 2008). Despite spending more on health the Under-five Mortality Rate is worse in South Africa, with the exception of Nigeria, as shown in Table 1 (Hugo, Allan 2008; Inter-agency group of child mortality estimation 2011).

Table1: Under-Five Mortality Rates in comparable countries to South Africa

Country	**Under-5 Mortality rate (deaths per 1000 live births)**		**Progress towards MDG target**
	1990	**2010**	
South Africa	60	57	Insufficient
Namibia	73	40	On track
Nigeria	230	138	Insufficient
Tunisia	49	16	Achieved
Malaysia	18	6	Achieved
Brazil	59	19	Achieved
Thailand	32	13	Achieved
Iran	65	26	On track
Cuba	13	6	Achieved
World	**89**	**60**	**Insufficient**

SA is one of only 12 countries where child mortality initially increased, rather than declined, after the baseline indicators for the Millennium Development Goals (MDG) were set in 1990. Now, with 57 deaths (see Table 1) under the age of 5 years per 1000 live births, SA is still likely to miss the target by 2015. SA, therefore, has made

reducing child mortality a national priority (Inter-agency group of child mortality estimation 2011).

Globally over 70% of under-five deaths occur within the first year of life of which pneumonia, diarrhoeal disease, preterm complications and birth asphyxia are the major killers (Inter-agency group of child mortality estimation 2011). In Africa HIV/AIDS and malaria are also important contributors to the burden of disease in young children. In 2006 South Africa's under-5 mortality rate was mostly due to acute respiratory infections, diarrhoeal diseases, malnutrition, and underlying HIV. Table 2 compares the distribution of causes of death in South Africa with Nigeria, Zambia and Brazil.

Table 2: Global distribution of causes of death in children under-five in percentages - 2010

	South Africa	**Nigeria**	**Zambia**	**Brazil**
HIV/AIDS	28	4	11	0
Pneumonia	11	14	14	7
Diarrheal Disease	5	11	9	3
Measles	1	1	4	0
Malaria	0	20	13	0

Although Table 2 shows a marginal difference in pneumonia, diarrhoeal disease and measles amongst these developing countries listed, South Africa's problem with HIV/AIDS stands out as a major driver behind the poor Under-five Mortality Rate. Trauma and violence against children has also emerged as a major threat (Rakha, El Naggar 2006).

The World Health Organisation (WHO) and the United Nations Children's Fund introduced the Integrated Management of Childhood Illness (IMCI) guidelines to help developing countries reduce the major causes of mortality in children under-five

years of age. The IMCI guideline, which promotes prevention as well as cure, and equity in the management of the child, has therefore been implemented in many countries to assist with reducing the burden of disease.

IMCI is an integrated approach to child health that focuses on the well-being of the whole child. IMCI aims to reduce death, illness and disability, and to promote improved growth and development among children under five years of age. IMCI includes both preventive and curative elements that are implemented by families and communities as well as by health facilities. The IMCI guidelines provide a standardised integrated approach to delivering quality care. The strategy includes three main components:

1. Improving case management skills of health-care staff
2. Improving overall health systems
3. Improving family and community health practices

The IMCI guideline is predominantly used in primary health care settings to assist in making an assessment and initiating management without the assistance of a doctor. In terms of case management the IMCI guideline is a syndromic approach, where a limited number of carefully selected symptoms and signs (with the highest sensitivity and specificity) are the entry point. The IMCI strategy promotes the accurate identification of childhood illnesses, ensures appropriate combined treatment of all major illnesses, strengthens the counselling of caretakers and speeds up the referral of severely ill children. In the home setting, it promotes appropriate care seeking behaviours, improved nutrition and preventative care, and the correct implementation of prescribed care.

In South Africa, the IMCI was adopted as a national guideline in 1997 and the strategy has been expanding its influence, with thousands of health professionals trained in all 52 districts in the country (Maboe, De Villiers 2011). The Western Cape Department of Health IMCI guidelines have been adapted from the WHO's guidelines to include priority conditions affecting children in our context. These illnesses are managed from when the child is one week to five years old:

- Diarrhoea
- Acute respiratory infections
- Asthma
- Ear infections
- Malnutrition
- Tuberculosis
- HIV/Aids
- Child abuse
- Meningitis
- Management of the critically ill child

The national IMCI guideline can be used to better combat these conditions (Derenzi 2008; Chaunhary, Mohanty, Sharma 2005). Other studies have also indicated that quality of care and better case management improved since the introduction of IMCI (Schellenberg et al 2004). Throughout South Africa, medical students, health care workers and experienced paediatricians alike are learning the value of IMCI as a guide for paediatric consultations, one that significantly reduces the chances of missing something that may be wrong with a child (Maboe, De Villiers 2011).

Use of IMCI guidelines improves clinical skills of trained health workers and reduced the cost of training health workers (Takada, 2007). Adherence to the guidelines can make a major difference to the quality of care and has the potential to improve child health (DeRenzi 2008; Horwood 2009; Maboe, De Villiers 2011). In a Tanzanian study the cost of hospitalisation was about 50% less in districts that practiced IMCI because admissions were reduced (Adam et al 2004). This provides evidence that if the IMCI guidelines are adhered to the cost of health care can be reduced. By using IMCI, more thorough assessments were done and children were classified more correctly than those in the non-IMCI districts (Schellenberg et al 2004).

However, despite intentions, the introduction of IMCI did not have a significant impact on child mortality in countries like Uganda, India and South Africa (Takada, Oudavoug, Kuroiwa, 2007). Implementation of IMCI was constrained by insufficient coverage and poor adherence, and this was thought to be responsible for the lack of

improved quality of care and outcomes (Horwood 2009; DeRenzi 2008). Ineffective implementation of IMCI due to non-adherence, with incorrect or incomplete assessments, is a critical factor in the poor management of the child (Horwood 2008; Chaudhary, Mohanty, Sharma, 2005; Tavrow et al 2002).

Previous studies indicate that adherence to the guidelines decreases over time due to inadequate initial training, shortage of staff and insufficient supervision (Chaundhary 2005). Critical interventions may be omitted due to lack of knowledge and skills (Mugala 2010; DeRenzi 2008). This study focused on the issue of training and its relationship to improving adherence to the guidelines.

The WHO recommends an 11 day standard (paper-based) training course which describes the problem of childhood illness, the need for integrated case management guidelines, and the case management charts. This usually includes approximately 8 days of classroom teaching and 3 days of supervised clinical practice. A systematic review conducted by Rowe et al (2008) established that the 11 day training course, when compared to a shortened course of between 5 – 10 days, showed very little difference in terms of the performance of health workers post training. According to the review the exact effectiveness of a longer standard training course is unclear.

In our setting the time available to teach IMCI to nurses in the one year Diploma programme at Stellenbosch University meant that a shortened course was necessary. The Diploma programme allocated a 3-day classroom based training on campus, followed by 5-days of supervised clinical practice in training sites.

Apart from the length of the training course other factors include the competency of the trainers as well as sufficient follow-up and support of trainees after the initial course (Tavrow et al 2002). All IMCI trainers are expected to have done the 11 day training course as well as an IMCI facilitator's course (Horwood, Voce et al 2009). Ongoing constant supervision of health workers is required as well as regular training, which Mugala (2010) and Horwood (2009) show is presently lacking. Other factors such as the cost implications of different approaches to IMCI training have also been noted (Tavrow et al 2002). In a Ugandan study, IMCI trainees who did a 9 day IMCI training course with a computer based guideline, showed better adherence

to the guideline over time compared to the trainees using the paper-based format (Tavrow et al 2002). Use of technology therefore may be another important innovation that can impact on success of training and adherence to the IMCI guidelines.

Technology is rapidly advancing and can offer quicker, more efficient and effective access to information. The use of computer technology can contribute to the improvement of health services and quality of care of citizens (Cheng, Ernesto, Truong 2008; Peters et al 2006). A study in India shows that even patient satisfaction improved when decision support technology was used (Peters et al 2006). In South Africa, nurses are challenged by these technological advances, especially within primary care health system where exposure to technology seems to be minimal. Nurses need to acquire technological competencies to keep up with the changing world. Maboe & de Villiers (2011) support the idea that nurse educators should introduce and incorporate technology into the teaching and learning curriculum in South Africa. Information and technology is widely used to support educational programmes and allows health care workers more universal communication to access health information (Baker, Lasserre 2005).

A study in Uganda verified that computer-based training of IMCI can be as effective as standard training and considerably less expensive (Tavrow et al 2002). Although training can become less expensive due to the reduced time for training and fewer facilitators. The use of technology can be expensive despite the competitive market for mediated-electronic systems that has resulted in the reduced cost of computers and electronic devices. The expense depends on the type of technology (hardware), decision support applications (software) and the computer literacy of the user. Nevertheless the cost of technology must be evaluated in light of the shortened training time and greater effectiveness of clinical practice (Anantraman 2002; DeRenzi 2008). Peer education and self-directed learning with the automated IMCI guideline may be responsible for the reduced need for facilitators (DeRenzi 2008). An initial study on the use of automated IMCI guidelines in Tanzania indicated that health workers were able to use personalised digital assistants (PDAs) at the point of care to follow IMCI guidelines. More importantly, the automated IMCI guidelines

reduced unintentional deviations from IMCI that led to improved adherence and quality of care (DeRenzi et al 2008; Mitchell et al 2008). This study chose to use a convertible classmate personalised computer for better visual effect of graphics, font size, robustness and practicality. PDA's have similar features but with smaller screens.

Studies have shown that when using the electronic version, training time was reduced in both those previously trained as well as those not previously trained (Mitchell et al 2008; DeRenzi et al 2008; Tavrow 2002). The overall difference in knowledge of IMCI by health workers using the paper-based and automated versions was less than one percentage point as shown in a Kenyan study in 2006. Chaundhary (2005) demonstrated that the adherence of health workers improved after more than one regular follow-up post-IMCI training compared to those health workers who were followed up only after one year of training.

The work of Takada, Oudavong & Kurolwa (2007) was concerned that when health workers found the IMCI chart booklet tiresome they tried to work from memory and were less adherent. In some instances health workers felt the need to omit sections as working through all the sections took too long and this resulted in incomplete assessments (Takada, Oudavong & Kurolwa, 2007; Mugala et al 2010). By contrast electronic IMCI automatically leads the health worker through the algorithm, with less or no choice as to the next step (DeRenzi 2008). In the automated version steps cannot be missed, because of the design of the software programme; and therefore it should result in more adherent and comprehensive clinical management.

This study explored the use of a new automated version of the IMCI guideline during the training of professional nurses. The automated guideline, in the format of a computer tablet (see Figure 1), aimed to improve training in and adherence to the IMCI guidelines. The comprehensive automated IMCI guideline, which includes all the IMCI algorithmic components, is a new innovation in SA and nothing has yet been established on the topic. Studies of electronic decision support tools conducted elsewhere in South Africa have concentrated on components of the guidelines such as HIV, AIDS and TB as these conditions are ranked as the largest contribution to the burden of disease (Horwood 2009; Peters 2005; Timmerman et al 2008; Mitchell et

al 2008). Examples of these decision support tools include a software programme for Early Diagnosis and Prevention System in South Africa and Computer Assisted Personal Interview applications (Fairall et al 2009).

Figure 1: Nurse using the convertible classmate personalised computer tablet with stylus

2. Study Question

This study therefore asked the following question: Does the use of the automated IMCI guideline compared to the paper-based guideline, lead to better adherence to the guideline in clinical training practice at the end of training for Professional Registered Nurses enrolled in the Diploma in Clinical Nursing Science; Health Assessment, Treatment and Care at Stellenbosch University?

3. Aim and Objectives

3.1 Aim

To evaluate the use of automated IMCI guidelines for sick children aged 2 months to 5 years in improving adherence to the guideline at the end of training for Professional Registered Nurses enrolled in the Diploma in Clinical Nursing Science; Health Assessment, Treatment and Care offered by the Division of Nursing, Stellenbosch University.

3.2 Objectives

1. To compare the professional nurse's knowledge of the IMCI guidelines at the end of a 3-day IMCI training course utilizing the automated, tablet-based version of IMCI and the same 3-day course utilizing the paper-based version.

2. To compare the professional nurse's adherence to the IMCI guidelines during 5-days of clinical training practice at training sites, following the classroom based teaching when using and not using the automated version.

3. To explore the experience of those professional nurses who used the automated guidelines.

4. Methods

4. 1 Study design

An observational study design compared groups of professional nurses trained with the paper-based version versus the automated version of IMCI guidelines.

4. 2 Setting

The study population was drawn from 230 nurses who attended a one year Postgraduate Diploma in Clinical Nursing Science; Health Assessment, Treatment and Care in 2010 in the Division of Nursing at Stellenbosch University. The students worked at Primary Health Care facilities for the City of Cape Town and the Provincial Government of the Western Cape, as well as for hospitals in both the private and public sectors. All students attended part time theoretical sessions on a once a month basis at the University as well as training practices in public sector primary

care facilities. At the end of a successful 1-year training course these nurses are registered by the South African Nursing Council and may then practice as clinical (family) nurse practitioners within their work settings.

4.3 Selection and sampling

Figure 2 illustrates the process of selecting nurses for the study.

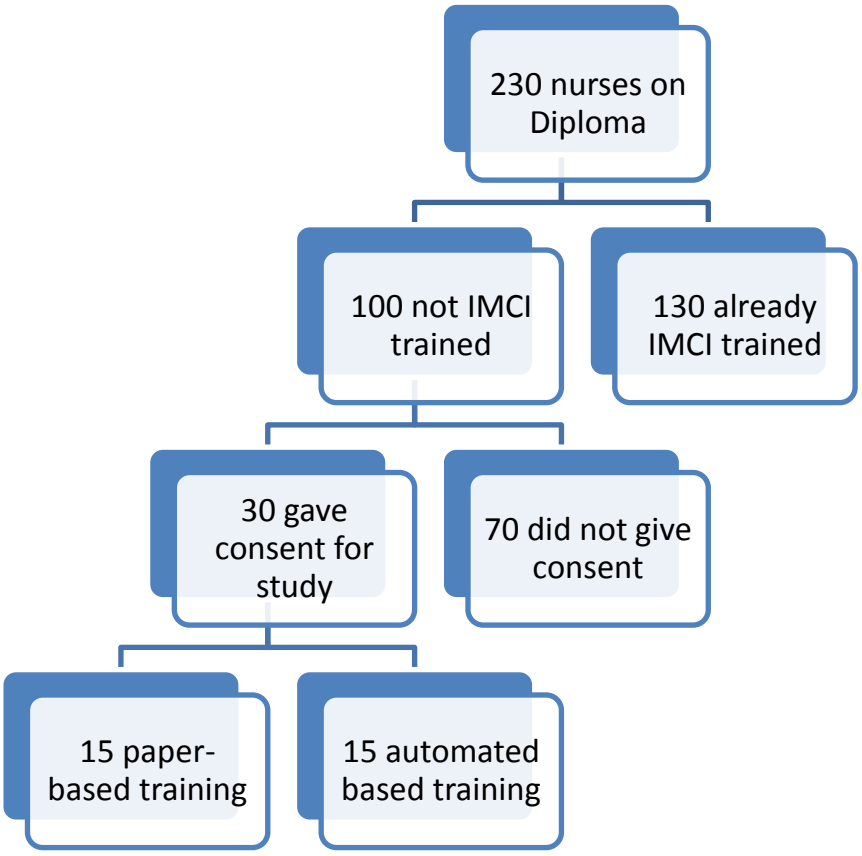

Figure 2: Selection and sampling of the study group

Out of the 230 Professional nurses (PNs) 130 had already done the IMCI paper based course and therefore 100 PNs still had to be IMCI trained. The untrained IMCI nurses were identified by a questionnaire administered to the whole class (see Appendix 10.1). All nurses on the Diploma programme must have received training in IMCI in order to manage children in primary care.

Nurses who were not previously trained in IMCI were invited to participate in the study. Only thirty nurses out of the 100 agreed to take part. The remaining nurses declined to consent to the study.

Fifteen nurses were then allocated to the usual paper-based training and 15 to the automated-guideline training. Allocation was based on the location of their training practice, so that all nurses at a given location were trained in the same way, and on the need to balance nurses from rural and urban sites in both groups. Allocation was therefore purposeful, but based on these criteria. This is shown in Table 3.

Table 3: Number of nurses allocated to different clinical training sites

Clinical Sites	**Type of location**	**Automated Participants**	**Paper-based Participants**
Lentegeur	Urban	1	0
Simondium	Rural	0	5
Delft	Urban	1	0
Wellington	Rural	4	0
Green Point	Urban	4	0
Worcester	Rural	0	1
Vanguard	Urban	0	3
Kraaifontein	Urban	0	2
Bishop Lavis	Urban	2	0
Mitchells Plain	Urban	1	0
Paarl	Rural	0	1
Idas Valley	Rural	0	2
Bishop Lavis	Urban	2	0
Grabouw	Rural	0	1
Total sites: 14		**15**	**15**

The Power analysis for independent t-Test analysis in the study outcomes suggested that to compare two groups a sample size of 15 in each group would give 88% power to detect a significant difference at the end of the 3-day classroom based teaching. Similarly the Power analysis for sample size calculation suggested that an independent sample t-Test of 60 patients per group would give 80% power to detect any difference during the 5-days of clinical training. The sample size calculation was performed by the Centre for Statistical Consultation, Stellenbosch University.

4.4 Development of the automated guidelines

The study instrument consisted of the pre-programmed automated IMCI national treatment algorithms (initial visit) for children from 2 months up to 5 years. The electronic device was a CTL 2go touch screen Convertible Classmate PC with a keyboard option: size 24.1x19x3.8cm, weight 1.36kg with a screen solution of 1024x600. Users therefore had the choice of either using the touch screen or a keyboard. Battery life was five hours. The application was Windows Forms .NET framework 3.5 running on the Windows XP operating system. Assessments were stored as XML files on a hard disk drive. Information was encrypted for patient confidentiality. The software included all aspects of the IMCI initial assessment including the general assessments and treatment of danger signs, cough or difficult breathing, wheezing, diarrhoea, fever, ear problems, malnutrition, anaemia, HIV infection and TB, immunization status, measles, treatment of all the IMCI classifications , feeding assessment, counselling, follow-up recommendations and a summary of the data. Software was developed by Expert-24, a UK company with expertise in automation of clinical guidelines. Expert-24 is a knowledge automation company that developed "World Doctor" patented decision-support health systems intended for use by doctors and nurses. After extensive consultation between Expert-24 and the Division of Family Medicine and Primary care at Stellenbosch University, Expert-24 undertook to write and adapt the automated WHO IMCI guidelines for the Western Cape in South Africa.

The automated computer-assisted guideline was designed to systematically guide the nurse through the IMCI, reducing errors and making it more effective. It provided a warning to take urgent action where necessary and at the end offered a summary of

the patient's classification, key features and recommended management. The software guided the practitioner to gather information, make an assessment and decide on management of the patient, and was devised to mirror the IMCI flowchart (patient case recording form) that is currently documented in the patient folder. In addition a database of other resources and explanatory material was incorporated into the software for quick reference. This resource material could be used during workshop training as well as clinical training practice.

A pilot study was conducted at Stellenbosch University with four qualified clinical nurse practitioners who had prior training in IMCI and worked for the local municipality. These nurses helped Expert-24 to ensure that the software algorithm was clinically reliable and exactly replicated the decision making pathways in the SA version of the IMCI guideline. Piloting also established that nurses in our context were able to use the hardware. The approximate time taken to complete an assessment was piloted as well as the development of library resources and associated graphics.

4.5 Training in IMCI guidelines

Training was given by the researcher at Stellenbosch University, who is IMCI trained, and has practical experience from working in municipal clinics. Three 3-4 hour workshops were run over three non-consecutive days. This entailed the classroom aspect of the training. Classroom training involved theory, a DVD on IMCI related clinical skills, followed by practice on simulated and real cases of childhood illness by using the guideline and case recording form. Training was identical except for use of either the automated or the paper-based version of the guideline during training.

The automated group also received training on relevant computer skills. The keyboard was not a requirement, but an option, as training was done utilizing the touch screen modality. Minimal text would be typed if the child for example displayed symptoms outside of the IMCI classification. An example of this would be "nappy rash" or "impetigo".

Following on from the 3-day classroom based workshop, clinical training practice was completed at the allocated training site over a 3-month period. Nurses attended the training sites for 1-day a week and saw patients under the supervision of a nurse

trainer. At this time the nurse trainers were not fully trained themselves in IMCI. Training sites were therefore not the participants' usual place of work. The total number of hours spent on consulting children under the age of 5-years was estimated as 40 hours or the equivalent of 5 days.

4.6 Data collection

Knowledge of IMCI was assessed before and after training in both groups using a standardised test of 30 multiple choice questions (see Appendix 10.2) based on a previously validated tool used by a Kenyan study (Quality Assurance Project 2006). The same multiple choice questions were used for both pre- and post-test by rearranging the order of the questions.

After the initial training workshop the medical records of all children less than 5 years seen by the nurses of both the automated and paper-based groups during their subsequent clinical training were examined using a standardised data collection tool based on the Kenyan study (see Appendix 10.3) that recorded information on the demographics, assessment, classification, treatment and counselling in terms of what the IMCI guidelines expected (Quality Assurance Project 2006). The paper-based nurses were making their notes on a standardised medical record form provided by the health services (see Appendix 10.4). The Professional Nurses saved their medical record on the computer and data on their consultations was retrieved from the hard drive.

The researcher developed an interview guide to assist with the interviews of the participants at their place of work (see Appendix 10.5). Semi-structured individual interviews were held with 10 nurses who used the automated version to explore their experience of the new approach. Interviews were held in English but some participants chose to respond in both English and Afrikaans. The Afrikaans excerpts were translated into English by the researcher. The qualitative data was recorded and transcribed by a professional typing and transcription company. The quality of the interview and interview guide was reviewed after the initial interview with the second author and minor changes made.

4.7 Data analysis

Quantitative data was analysed to compare the two groups in terms of their improvement in knowledge after the initial classroom-based teaching and in terms of their adherence to the IMCI guidelines during clinical training practice. Statistical significance was reported using a 95% confidence interval and a 5% significance level ($p<0.05$). The M-L (maximum-likelihood) chi square and observed frequencies were used for analysis of categorical data.

Qualitative data analysis was performed by using Atlas. ti and the Framework method (Pope, Ziebland, May 2000).This included the following 5 steps: (1) Familiarization with the data obtained, (2) Creating a thematic index, (3) Coding the data according to the index, (4) Charting the coded data and (5) Interpretation of the results.

4.8 Ethical approval

Ethical approval was granted by the Health Research Ethics Committee of Stellenbosch University (N09/12/349). Permission for the study was also obtained from the Division of Nursing at Stellenbosch University, the Department of Health, Provincial Government of the Western Cape and the Director of Health for the City of Cape Town. Permission was obtained from the facilities where the nurses worked.

Informed written consent was obtained from the nurse participants before commencing their training course.

The patients were not directly involved in the study as the nature of their clinical care using the IMCI guidelines remained unchanged. The only difference was in the training of nurses in use of the guidelines. The assessment and management of patients was not changed from the current standard of care in either group. In addition the PNs had to use their clinical judgment as to the applicability of the automated information to the management of any specific patient.

Software was encrypted for confidentiality of patient data and could only be accessed by the PN or researcher. No patient identifiers were used in analysis and reporting. Likewise the confidentiality of the PN was respected and her/his identity was not used in the analysis and subsequent reporting.

The PNs participation in this study was voluntary and she/he could choose to leave the study at any time without penalty or prejudice in any way.

5. Results

Thirteen nurses were trained using the paper based version (two nurses withdrew from the diploma course just prior to training) and 15 with the automated version. After the initial automated classroom-based training session, which included the pre- and post-tests, it was discovered that four participants had already done the IMCI course and were hence excluded from the study only after the classroom-based training and after having written the test. They therefore did not do any clinical training as part of the study. The remaining 11 participants continued with the study.

The 24 nurse participants ranged in age from 23 to 62 years with one male nurse. The nurses came from different cultural backgrounds of which 5 were white, 18 coloured and 7 African and geographic locations that ranged from urban Bellville to rural Worcester.

5.1 Prior computer skills

Only 13 (54.2%) nurses had used email, while 20 (83.3%) had typed a Word document in the previous year and 22(91.6%) were used to using a cell phone. However of those who had typed a Word document, 8 (33.3%) had done this less than 10 times in the previous year. Only 2 (8.3 %) of the participants had no confidence to use a personal computer, 12 (50.0%) felt somewhat confident 6 (25.0%) felt confident and 5 (20.8%) felt very confident.

5.2 Knowledge test scores

Table 4 shows the knowledge test scores before and after the classroom-based training course. Four participants in the paper- based group failed to comply with writing the post test and therefore no scores were available for them.

Table 4: Percentage scores for pre and post test in paper-based and automated groups

Paper based					*Automated*					*P Value*
Variable	***N***	***Mean %***	***CI***		***Variable***	***N***	***Mean %***	***CI***		
			-95.0%	***+95.0%***				***-95.0%***	***+95.0%***	
Pre test	*13*	*58.5*	*51.5*	*65.3*	***Pre test***	*15*	*56.5*	*50.0*	*62.9*	0.467
Post test	*9*	*62.2*	*53.5*	*70.9*	***Post test***	*15*	*64.5*	*57.7*	*71.2*	0.729

Although both groups significantly improved in their post test performance scores there was no significant difference between the two groups at baseline or after training in their understanding of the IMCI guidelines.

5.3 Assessment of IMCI consultations

Eighty children were consulted by these nurses and included in the study; 30 in the automated group and 50 in the paper-based group.

During the clinical training practice phase, 3 of the tablets did not record any consultations, which reduced the number available for analysis. One had a virus which deleted the IMCI programme, while the other 2 participants had seen 10 patients each but because they used the training mode on the tablet the consultations were not saved in the database.

Table 5 shows a profile of the clinical problems presenting to the nurses. The main problems in descending frequency were cough, fever, ear related and diarrhoea.

Table 5: Main classification of problems identified

Main complaint	Specific complaints and observations	Number of children N=80 n (%)
Cough		46 (57.5)
	Chest indrawing 3/46 (6.5%)	
	Stridor 2/46 (4.3%)	
	Mean days of prior symptom 4.7 (CI:3.3-6.1)	
Diarrhoea		10 (12.5)
	Blood in stool 1/10 (10.0%)	
	Given fluids by mother 4/10 (40.0%)	
	Sunken eyes 2/10 (20.0%)	
	No children with sunken fontanelle	
	Mean days of prior symptom 3.3 (CI:1.9-4.7)	
Fever		23 (28.8)
	Children with temperature >37.5^{o}C 6/23 (26.1%)	
	No children with stiff neck or bulging fontanelle	
	Mean days of prior symptom 2.2 (CI:1.3-3.07)	
Ear Problem		16 (20)
	Pain 10/16 (62.5%)	
	Ear pain that awakes the child 4/16 (25%)	
	Visible pus 1/16 (6.3%)	
	Discharge reported 1/16 (6.3%)	
	Swelling behind ear 2/16 (12.5%)	

During the initial assessment the nurse should identify the reason for the child's visit, record the child's age, measure the child's weight and temperature and record these in the patient medical record. Figure 3 shows the number of children with a raised temperature of which only 6 children had a temperature above 37 Celsius. The child would then be assessed. All children should be assessed for general danger signs, (danger signs present is an indication that a child needs urgent referral) malnutrition and anaemia, HIV, TB contacts and immunisation status according to the appropriate age for each dose. Assessment of feeding should be done if the child has anaemia, not growing well or is below the age of 2 years.

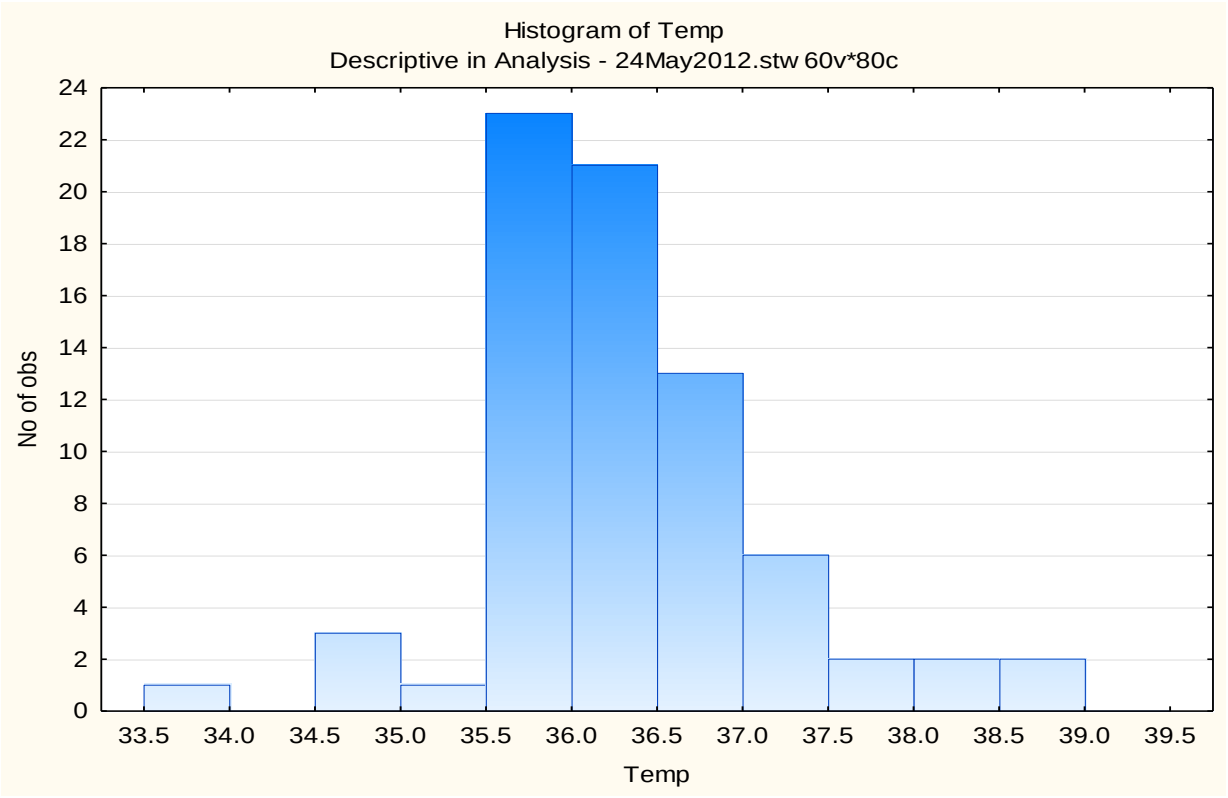

Figure 3: Distribution of temperatures

Table 6 presents results that evaluate the key IMCI steps that should be completed by the nurse when a caregiver brings a sick child to the clinic. These steps involve gathering information about the problem as well as growth, immunisations and risk of HIV and TB.

Table 6: Gathering information: Comparison of outcomes for traditional and automated groups

Variable	Traditional N=50 n (%)	Automated N=30 n (%)	P value
Was the reason for encounter recorded	47 (94.0)	28 (93.3)	0.905
Was the age recorded	44 (88.0)	30 (100.0)	0.014
Weight recorded	48 (96.0)	30 (100.0)	0.166
Growth monitoring recorded in terms of nutritional status and anaemia	45 (90.0)	30 (100.0)	0.026
Temperature taken and recorded	45 (90.0)	29 (96.7)	0.246
Previous HIV testing in child or mother recorded	25 (50.0)	28 (93.3)	<0.001
Any close TB contact recorded	22 (44.0)	28 (93.3)	<0.001
Immunisation status recorded according to the immunisation schedule and age of child	34 (68.0)	28 (93.3)	<0.001
General danger signs observed and recorded	47 (94.0)	30 (100.0)	0.089

Regarding information gathering, it emerged that although there was no difference between the two groups in terms of information on the immediate clinical problem, the automated group performed significantly better in terms of more comprehensive information on growth, immunisations, HIV and TB risk.

5.4 Comparison of assessment outcomes

Assessments were classified as correct if the assessment was congruent with the clinical information recorded as per IMCI and incorrect if the clinical information implied a different classification. If there was insufficient information to determine whether the assessment was correct then it was classified as indeterminate. Assessments were classified as complete if all of the presenting symptoms were classified as well as the 4 compulsory assessments of nutritional status, anaemia, HIV status and TB that are required in all patients by the IMCI guidelines. The results are shown in Table 7.

The automated system made allowances for the practitioner to override the assessment and two nurses changed the classification from "Possible HIV" to "HIV infection unlikely" despite the child having one or two features of HIV present.

Table 7: Comparison of assessment outcomes for children seen using paper-based and automated IMCI guidelines

Variable	**Paper-based N=50 n (%)**	**Automated N=30 n (%)**	**P value**
Correctness of assessments			
Correct assessments	26 (52.0)	29 (97.0)	<0.001
Incorrect assessments	7 (14.0)	1 (3.0)	0.178
Indeterminate assessments	19 (38.0)	0 (0.00)	<0.001
Completeness of assessments			
Completeness	31 (61.0)	30 (100.0)	<0.001

The automated group recorded sufficient information to make a correct assessment in almost all children. The paper-based group had insufficient information recorded in more than a third of children, which made it impossible to determine if the actual

assessment was correct. In addition the automated group made significantly more complete assessments.

Table 8 compares the two groups in terms of their management of the children.

Table 8: Comparison of management plan for paper based and automated groups

	Paper based N=50 n (%)	**Automated N=30 n (%)**	**P value**
Correct medication	13/26 (50.0)	11/13 (84.6)	0.029
Correct dose	11/26 (42.3)	11/13 (84.6)	0.005
Advice on feeding explained and recorded	34 (74.0)	20 (95.2)	0.024
Safety netting advice explained and recorded	39 (78.0)	22 (95.6)	0.037
Advised when to return immediately and recorded	33 (66.0)	20 (90.9)	0.018
Mother's health asked	42 (84.0)	23 (88.5)	0.594

In those where medication should have been prescribed the automated group performed significantly better in terms of the correct medication and dose. In terms of appropriate feeding advice and safety netting the automated group offered better management of the patient compared to the paper based group. The automated group therefore appeared to offer a more comprehensive and safer consultation.

5.5 Experience using the automated version

One participant changed jobs and moved to another Province and could not be contacted telephonically. Therefore 10 participants were interviewed at their place of work. Key themes that emerged from the qualitative data were:

Need for more training in computer literacy

Nurses reported that the automated version took longer to use because they had a lack of computer skills and had limited time to learn such skills during their busy curriculum. There was quite a range of initial proficiency in using the computer tablet. Some lacked confidence because they were unfamiliar with computers:

> *"Yes definitely it's just the time management that is the problem for me because for the one the person must be computer literate that's the first thing. A person must be able to work on a laptop very quickly and sometimes you press one of the wrong buttons or it just slips, so maybe just switching backwards and forwards again it also takes time. So you have to be computer literate to do this so everyone must go on a computer course and also you have to train people to be able to type quickly and fast".*

> *"I think you must be more skilled to work with it. With a portable PC. It is really working. It is really helping a lot. The guidelines but just that if you are not skilled then you feel a bit uncomfortable or because you are scared that you can break something on it. Especially I was scared that I can break something".*

Nurses' preferences were catered for as they were able to enter data using the touch screen or the keyboard as well as vary the orientation of the page from portrait to landscape. They also appreciated that when using the touch screen the computer could be folded into a smaller tablet format as opposed to the more traditional laptop format required when using the keyboard:

> *"Yes I think it is nice but it's a bit uncomfortable for me to write on it. It's a small space and it's not like a paper you know like a real paper so I prefer the typing. I'm not really a very fast typer. I'm a bit slow so I would rather take the portrait version".*

> *"No, must say that thing is cute. Especially when you have to see patients, you just click, click, click and then continue. With the pen, when you have to enter or what now. So the touch screen was nice".*

"I preferred using landscape yes but there were moments when my desk gets cluttered I did the portrait and also for the writing I did the portrait. It was easy for me to turn it, put it back and then to continue".

Improved diagnostic ability

Nurses reported that the automated version led to diagnoses that they would not have usually considered and ensured that they followed a logical decision making pathway. Nurses felt more secure knowing that they had not been allowed to miss anything:

"Did not think that the diagnosis would give meningitis. Learnt something as child was referred."

"It leads you from the one thing to the other thing that you did not really expect."

"The other benefit that you get is that it protects you from any risk, medical or legal that you could have missed."

Improved clinical management

Nurses reported that the automated guideline was easy to use and was useful in summarising the required management of the patient. They did not have to look elsewhere for information on prescribing:

"For me this was all new, so along with the whole concept and along with the IMCI booklet and doing it on the PC was nice for me, having it like that and it gives you the treatment, it gives you what you need to do. You don't have to go and page through the book because you can't obviously remember everything."

"I think the flow was nice and the prompts are understandable. I didn't have any problems with any of it".

"There is a prompt that says there is another problem. Then you have to actually go to the EDL or IMCI booklet to see the medication. It (PC) would

give you the medication, so that was nice, it would give you the amount, whether you are using 250mg or 125mg".

Comprehensiveness

Nurses reported that the automated guideline offered additional information not found in the paper based guideline, which in turn made care more comprehensive:

"When you look at the IMCI booklet, not everything is on that particular page, you have to page around because eventually at the end of it when you are doing your health education you focus on the most important things. But there are additional things on here that you forget when you are doing the booklet and this is very nice because if you do it comprehensively, exactly then what you should have discussed with the patient".

Opportunity for health education

The automated guideline offered prompts as a reminder which could be used for health education:

"You focus on the most important but your health education will be better because you will talk about those things that are there, instead of having to look what else I need to do. So this just puts the whole treatment in a nut shell for you".

Improved standard care

Nurses reported that the automated version improved the quality of care:

"I mean right now we are busy and I think for a new person coming in and having that paper version it's very daunting. This is more [I wouldn't say like a crutch] but its more guiding in terms of the staff here having gone for updates recently. So now I have just done IMCI, so I am updated and when they speak about diarrhoea they don't give zinc, that type of thing. This would then guide everyone to do the same thing, so you wouldn't be having that issue of a child that had diarrhoea for however many days didn't get zinc or

whatever. There's a lot of things it would cover and there wouldn't be too many gaps. We would all be doing the same thing which is a great help".

Efficient use of time

Nurses reported that by using the automated version during a busy clinic session more patients could be seen and time was used more efficiently:

"Definitely, you can see much more. I mean here on a day I was seeing fifty five of the paper version, which was horrendous because you leave here exactly on the dot half past four. Where this would make it quicker and we wouldn't be running back and forth to each other [maybe for the things that weren't part of IMCI] but as far as IMCI is concerned, I think we should see much, much more. And things would have been completed because you have to write out all the care for everyone, you can't just say according to IMCI you have to write out all those points whatever, all of that. So it will save a lot of time".

Nurses reported that patients would be happier with the potential reduced waiting time:

"I think the patients would be ecstatic that they could come out of here quicker. Everything will take much less time and streamline the whole thing".

Provides option of additional information

Nurses found that information and assessment that was not part of the IMCI algorithm could be added, providing completion of patient care:

"If they had eczema or anything like that? I just added a note so it wasn't that bad I mean you can use your EDL then and ja, it wasn't a train smash".

Use of cognitive skills and different understanding of HIV risks

When nurses disagreed with the automated guideline classification, they were able to review the classification and establish reasons for the change:

"The section about the HIV. There I disagreed a lot of times with what it was saying was possible when I really thought when I looked at the paper version of it, it was not [how do you say?] unlikely, HIV unlikely and a lot of the times it would say possible".

Ok, so what you did you just compared the automated with the paper? (Reflection by interviewer)

"Ja, because you could see it's possible HIV and then you have to test and then you have to speak about testing and things with the mother. But my own thing is, probably why it said possible is because the mother was doing the test. So that's why I thought that was probably the reason why. Where [I don't have the paper version here now] but that is probably the reason why because the mother is [say it's unknown] so that could be why the automated version is making it. But at least it prompts you in that way it's quite good then".

Accuracy of information

Nurses reported that after comparing outcomes with the paper based version that the automated version was more accurate:

"I went back and realised it was the right answer on the IMCI".

6. Discussion

Overall the nurses who were trained with the automated guidelines performed significantly better in their clinical practice in terms of their history taking, assessment and management. Their consultations were more comprehensive and paid attention to important preventative issues such as growth monitoring, immunisations and risk of HIV or TB. This improvement in clinical practice was not due to differences in the classroom-based teaching but to the support of clinical practice by the automated IMCI guidelines in the clinical training sites. The design of the automated programme prevented the nurse from easily deviating from the IMCI guidelines and therefore supported adherence to a more complete and comprehensive consultation. The use of the automated guidelines resulted in the

same level of understanding at the end of the classroom-based training, but gave significantly better outcomes in several clinical care variables.

The automated guideline demonstrates the potential to significantly improve adherence and with increased supervision and follow up the outcomes could improve even more significantly (Chaundhary 2005).

The duration of training required for adequate learning of IMCI is currently debatable. The WHO recommends an 11-day course and yet when the outcomes of training are compared to a 9 day course in Uganda, a 6 day course in Kenya and the 8-day course in this study the results are quite similar (Tavrow et al 2002; Quality Assurance Project 2006). Despite the shorter training programme in this study, as opposed to the 11 day traditional programme, the nurses in both groups displayed adequate learning outcomes as well as improved clinical practice. This implies that IMCI could be successfully taught in shorter courses and that automated guidelines may assist with this.

Although South African health workers have a clear written IMCI algorithm to guide them during assessment, management and treatment, the quality of care still seems to be poor (Maboe, De Villiers 2011). Availability of complete, comprehensive and accurate IMCI management of the child will assist us to reach our MDGs in 2015. The introduction and correct use of the automated IMCI guidelines as indicated in this study may be able to contribute to this goal. Health care workers therefore need to improve their computer literacy in order to be ready when such technology is introduced. Electronic tools are already applied in the HIV and AIDS programme in South Africa, which demonstrates the feasibility of technology in other areas (Fairall et al 2009; Horwood 2009).

The overall management of the child and adherence to the IMCI guideline can also improve with further follow up and supervision to reinforce the training received (Chaundhary 2005). However, the automated group in this study, showed better outcomes, without further follow up and supervision, when compared to Chaundhary's results in India. Nevertheless, without sufficient follow up the

motivation of health workers to use decision support technology becomes less, especially as their workload increases (Tavrow 2002; Peters et al 2006).

At the time this study was performed, the cost of the computer tablet was 3700 ZAR (450 US dollars) and this is likely to reduce with economies of scale. The software can also be incorporated into PDAs or smart phones. Most studies choose PC's for durability, practicality, convenience and robustness at the point of care (Mitchell 2008; Fairall et al 2009). The convertible tablet was chosen for the very reasons mentioned. In the long term the expense of purchasing affordable hardware may outweigh the poorer adherence found with the paper-based approach. Studies also suggest that paper-based training is more expensive in terms of the duration of training required and the cost of more human resources to facilitate learning (Fairall et al 2009). A recommendation is that a cost-benefit analysis be done in future studies to clarify these issues.

The other limitation of the automated version was that some nurses were not fully computer literate and therefore might not fully engage in the use of the automated algorithm (Maboe, De Villiers 2011). The attitudes and experiences of nurses towards the automated version were varied due to individual experiences and levels of computer literacy. Most nurses found this to be a positive new experience. The efficiency and ease of use of the software programme showed that although a few nurses were technologically challenged, all could manage to use the automated algorithm.

6.1 Limitations

As the consultations were not observed, the actual utilisation of the IMCI chart booklet during paper-based consultations was unknown and the researcher had to rely on the information recorded on the IMCI case recording form. This form usually required nurses to tick if a symptom or sign was present. If not ticked, however, it was impossible to tell if the question was asked. A consideration would be to modify the case recording form that the Province is presently using in future studies. By comparison the automated version recorded all possible answers. The results for correctness of classification reflected this problem of indeterminate as opposed to inaccurate classifications in the paper based group. The difference between the

groups for correct classifications may therefore be due to incomplete record keeping rather than incorrect classification. Differences in completeness of classification however would not be affected in this way.

Unfortunately the nurses in the paper-based group could not be completely isolated from exposure to other nurses who used the automated version, despite the purposive selection, as some nurses changed sites during their clinical training. However, nurses did not change their IMCI guideline format when training at a different facility.

During the nurses' clinical practice more emphasis was placed on adult assessment compared to under-5 children, because at this stage the clinical coordinators of the diploma course were not IMCI trained. The participants were initially eager to be part of the study, but later felt that it "interfered" with their more adult orientated clinical practice as students of the diploma course.

The final sample size was only 8 in the automated group due to inadvertent inclusion of nurses with prior IMCI training, loss of data when using the computer's training mode and computer viruses. Although excellent telephonic technical support and advice were provided, nurses did not make use of this service. Two paper-based participants left the Diploma course after initial selection into the study. A larger sample size may have yielded more power to detect significant differences. A reverse power analysis suggested that the study had only 75% power to detect a significant difference between the groups. Under powering may lead to differences being non-significant when they would have been different in the target population. Nevertheless the comparison of performance between the two groups showed some remarkable significant differences, which could impact on child morbidity and mortality. Care must also be taken in generalizing the results more broadly due to the non-random sampling technique.

A possible weakness of this study is that the subjective experiences of nurses using the paper-based version were not taken into consideration, although this was not one of the original study objectives. Perhaps interviewing both groups would have highlighted more aspects of the automated group's experience which were different.

6.2 Implications for practice and research

The potential benefits of automated guidelines need to be established in a larger study with better measurement of the effect on clinical care and outcomes.

The best technological interface for the software must also be considered as other devices, such as smart phones or ipads, may be more cost-effective than the tablets used in this study. Future studies should include cost-benefit analyses.

The integration of other decision support tools onto the same device should also be considered. A decision support tool such as the IMCI computerized adaptation and training tool (ICATT) could be beneficial for self-training as this interactive tool provides training support, a glossary of terms and clinical practice scenarios. This training tool could reduce the training time and compensate for a lack of fully trained facilitators as well as offer ongoing support post-training.

The benefits of using automated guidelines in terms of reducing the length and cost of training, while maintaining achievement of the learning outcomes, should also be further explored.

Finally, the ability of the automated system to maintain fidelity to the IMCI guidelines after training in clinical practice, when compared to usual levels of support, should be evaluated.

7. Conclusion

The knowledge of IMCI by nurses trained with the automated guidelines was as good as those trained with the paper-based version at the end of the classroom-based course. During clinical training adherence to the IMCI guidelines appeared better in the automated group in terms of the comprehensiveness of information gathered, completeness of assessments, and accuracy of prescribing and safety-netting activities. This study suggests that using automated guidelines in training is feasible although more attention must be given to those who lack confidence and skills in using computers or struggle to use keyboards as this could be a barrier to successful implementation. The potential for improved quality of care and clinical outcomes needs to be further studied along with a cost-benefit analysis.

8. Acknowledgements

The hardware and software were provided by Expert-24 Limited (Ltd) World Doctor Project which is a United Kingdom decision support software company. The Division of Nursing at Stellenbosch University allowed the study to be conducted in the Diploma programme. Dr. Justin Harvey from the Centre for Statistical Consultation assisted with the analysis. The Provincial Government of the Western Cape (Department of Health) and the Director of Health for the City of Cape Town who gave permission for the participants to conduct the study in the community health centres and clinics. I also wish to thank the study participants who gave of their time for the interviews and willingness to be part of the study.

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10. Appendices

Appendix 10.1: Initial selection questionnaire

INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS IN PRIMARY CARE

QUESTIONNAIRE

SECTION 1.				
1.1. Gender	Male		Female	
1.2. Age				
1.3. Home Language	English	Afrikaans	Xhosa	Other
1.4. Do you speak the language of your patients	Yes		No	
1.5. Where do you work?	Community Health Centre		Clinic	Mobile
1.6. Area of practice?	Rural District		Cape Metropole	
1.7. Previous IMCI course?	Yes		No	
1.8. Years of experience since qualifying as a general nurse				
1.9. Nursing qualification obtained	Basic Nursing Diploma	Postgraduate diploma/degree		Other

SECTION 2			
2.1. Prior to this course have you used the IMCI guideline?	Yes	No	
2.2. Do you use an electronic mobile device e.g. cellular phone?	Yes	No	
2.3. Do you use e-mail?	Yes	No	
2.4. Have you ever typed a word document?	Yes	No	
2.4.1 If your answer is yes please answer question 2.4.2			
2.4.2 How often have you typed a document in word in the past year?			
Less than 10 times	Between 10 – 50 times	More than 50 times	Every day
2.5. How confident are you in using a Personalised Computer (PC)?			
Not confident	Somewhat confident	Confident	Very confident

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

Appendix 10.2: Pre-test knowledge multiple choice questionnaire

Trainee Name: ..... Code: .....

Date:..... Training: Traditional / Automated

IMCI PRE - TEST KNOWLEDGE

***Instructions**: Check the ONE correct answer for each question. You may have up to half an hour to do this test*

1. In a 3 year old child with bloody diarrhoea for 2 days and no dehydration, which of the following would be appropriate treatment:
   a) Cotrimoxazole for 3 days
   b) Ciprofloxacin for 3 days *
   c) Amoxycillin for 3 days
   d) Erthyromycin for 3 days

2. ALL of the following are features of severe complicated measles in a 2 year old child, EXCEPT:
   a) Child has a rash
   b) Child has clouding of the cornea
   c) Child has convulsions*
   d) Child has deep or extensive mouth ulcers

3. ALL of the following should be checked when assessing malnutrition and anaemia, EXCEPT:
   a) Look for visible severe wasting
   b) Feel for oedema of both feet
   c) Look for palmar pallor
   d) Determine weight for age
   e) Check if the child is able to drink*

4. A 6 month old classified as severe pneumonia or very severe disease:
   a) Should be treated with amoxycillin only
   b) Should be treated for 3 days
   c) Needs to be given the first dose of antibiotic before urgent referral*
   d) Should always be tested for HIV prior to referral

5. Of the following, which one is a general danger sign:
   a) Chest indrawing
   b) Convulsions*
   c) Neck stiffness
   d) Severe wasting
   e) Fast breathing

6. In IMCI the definition of the sick child refers to:
   a) Age 1 week up to 2 months
   b) Birth up to 2 months
   c) Age 2 months up to 5 years*
   d) Age 2 weeks up to 5 years

7 Paracetamol should be given by a health worker to a 4 year old child if:
a) The child complains of feeling feverish
b) The history of the caregiver indicates fever
c) The temperature is 37.5^0C
d) The child feels warm or feverish
e) The temperature is 38^0C or above*

8. If a child has measles now and has fever and any general danger sign, the child will be classified as having:
a) Malaria
b) Severe complicated measles*
c) Very severe disease
d) Measles with eye or mouth complication

9. All children with diarrhoea should be given:
a) Amoxycillin for 2 weeks
b) Zinc for 2 weeks*
c) Oral rehydration solution for 2 weeks
d) Iron for 2 weeks

10. Which of the following iron supplementation can be given to a child who has anaemia: (1) Ferrous Gluconate (2) Ferrous Lactate (3) Ferrous Sulphate
a) All of the above*
b) Answer 1
c) Answer 1 and 2
d) Answer 2 and 3

11. What alternative drug can be given if a child is allergic to penicillin?
a) Amoxycillin
b) Doxycycline
c) Erythromycin*
d) Ciprofloxacin

12. What preventive therapy should be given for TB?
a) Lamivudine
b) Rifampicin
c) Isoniazid*
d) Pyrazinamide

13. What are the recommended scheduled doses of Prevenar (pneumococcal) vaccine in the public sector?
a) The recommended doses are given at 6 weeks, 8 weeks and 12 weeks of age
b) The recommended doses are given at 6 weeks, 12 months and 15 months of age
c) The recommended doses are given at 6 weeks, 12 weeks and 9 months of age
d) The recommended doses are given at 6 weeks, 14 weeks and 9 months of age*

14. In a child born to a HIV infected mother, a rapid antibody test confirms infection in the child when done at or after the age of:
a) 6 months
b) 9 months
c) 15 months
d) 18 months*

15. ALL of the following are appropriate actions if you have a 2 month child who is HIV antibody positive, EXCEPT:
    a) Start cotrimoxazole prophylaxis
    b) Refer the child for ART (anti-retroviral therapy) assessment
    c) Counsel the caregiver
    d) Do a PCR (polymerase chain reaction) test to confirm infection
    e) Start TB treatment*

16. What routine advice do the IMCI guidelines recommend that you give the mother about iron supplementation?
    a) Iron can make the stools look black*
    b) Iron may cause constipation
    c) Iron may cause nausea
    d) Iron may cause abdominal pain

17. A 12 month old child is said to have fast breathing:
    a) Only if breathing is 40 per minute or more*
    b) Only if breathing is 50 per minute or more
    c) Only if breathing is 60 per minute or more
    d) Only if breathing is 70 per minute or more

18. In a 2 year old child with recurrent difficult breathing and wheeze which of the following would be appropriate treatment:
    a) Salbutamol syrup

    b) Salbutamol MDI inhaler

    c) Salbutamol MDI inhaler and spacer*

    d) Theophylline syrup

19. A 12 month old with diarrhoea for 14 days or more can be classified as having severe persistent diarrhoea:
    a) If child had very low weight for age or visible severe wasting
    b) If child had blood in stool
    c) If child has sunken eyes, but no other sign of dehydration
    d) If child had at least two signs of dehydration*

20. To treat for low blood sugar (hypoglycaemia) in a child is when:
    a) The blood sugar is < 2.5 mmol/L
    b) The blood sugar is 5 mmol/L
    c) The blood sugar is < 3 mmol/L*
    d) The blood sugar is between 3 – 5mmol/L

21. If a 3yr old child visits the clinic with the some of the following symptoms: cough for more than two weeks or fever for more than 7 days or not growing well. How will you classify such a child?
    a) Pneumonia
    b) Fever other cause
    c) Suspected Malaria
    d) Consider TB*
    e) Severe malnutrition

22. ALL of the following are regarded as close TB contacts, EXCEPT:
    a) An adult who has had pulmonary TB in the last 12 months
    b) Who lives in the same household as the child
    c) Someone with whom the child is in contact for long periods of time
    d) A day visitor who is taking TB treatment*

23. Feeding should be assessed in a child who:
    a) Needs urgent referral
    b) Is more than 2 years old
    c) Is classified as having anaemia or not growing well*
    d) Is classified as having persistent diarrhoea

24. To be classified as having mastoiditis a child must have the following sign:
    a) Severe ear pain
    b) Redness behind the ear
    c) Pus draining from one of the ears
    d) Discharge for 14 days or more
    e) Tender swelling behind the ear*

25. The 3 new (EPI) Expanded Programme on Immunisation introduced by the Dept of Health in South Africa are:
    a) Hepatitis B (Hep B), Pneumococcal Conjugate Vaccine (PCV), Rotavirus vaccine (RV)
    b) DtaP-IPV/Hib (Pentaxim), Rotavirus vaccine, Hep B
    c) Measles, Oral Polio vaccine, Tetanus
    d) Rotavirus vaccine, Pneumococcal Conjugate Vaccine (PCV), DtaP-IPV/Hib (Pentaxim)*

26. Choose the best question to check the mother's understanding about how to give an antibiotic:
    a) How will you give the antibiotic*
    b) Will you give the antibiotic three times a day?
    c) For how many days will you give the antibiotic?
    e) Do you understand how to give the antibiotic?

27. An acute ear infection is defined as having an ear problem for less than:
    a) 7 days
    b) 14 days*
    c) 21 days
    d) 28 days

28. A child with fever plus any general danger sign should be classified as:
    a) Measles
    b) Very severe disease*
    c) Fever other cause
    d) Acute ear infection

29. The IMCI clinical guidelines describe how to manage a child with ALL the following, EXCEPT:
    a) with a chronic disease*
    b) with acute illness
    c) with immunisations
    d) with malnutrition

30. A child with HIV infection often presents with: (1)Pneumonia (2) Persistent diarrhea (3) Very low weight for age (4) Enlargement of the lymph nodes in at least two sites (5) Oral thrush
    a) All of the above*
    b) Answers 1, 2 and 5
    c) Answers 3 and 4
    d) Answers 1 and 5

Appendix 10.3: Data collection tool for clinical training practice

Trainee Name: _____ Code: _____

Date: _____ Training: □ Traditional □ Automated

SKILLS CHECKLIST – FOR INITIAL VISIT CHILD 2 MONTHS TO 5 YEARS

In ALL children:

1.	Did the health worker enter why the child was brought to the facility?	Y	N
2.	Did the health worker record the age of the child?	Y	N
3.	Was the child's weight recorded in the folder?	Y	N
4.	Was the child's weight interpreted in the folder for weight gain or weight loss?	Y	N
5.	Was the child's temperature recorded?	Y	N
6.	Did the health worker measure the Hb according to palmar pallor?	Y	N
7.	Did the health worker record if the child has been tested for HIV or if the mother has been tested for HIV?	Y	N
8.	Was the close TB contact recorded?	Y	N
9.	Was the immunisation status recorded in the folder?	Y	N

10. Were any danger signs present?				**Y**	**N**	
Did the health worker record the following General Danger signs?						
a. Is the child able to drink or breastfeed?	Y	N	c. Is the child lethargic or unconscious?	Y	N	
b. Does the child vomit everything?	Y	N	d. Has the child had convulsions during this illness?	Y	N	

The section below relates to the child's main symptoms: Cough or difficulty breathing; wheeze; diarrhoea; fever; ear problem

11. Cough or difficulty breathing	**Y**	**N**	N/A	**12. Wheeze**	**Y**	**N**	**N/A**
a. Recorded for how long	Y	N		a. Recorded if the child had a wheeze before?	Y	N	
b. Recorded number of breaths per minute?	Y	N		b. Recorded if the child frequently coughed at night?	Y	N	
c. Recorded chest in-drawing	Y	N		c. Recorded if the child had a wheeze for more than 7 days?	Y	N	
d. Recorded stridor or wheeze	Y	N		d. Recorded if the child on treatment for asthma?	Y	N	

13. Diarrhoea	**Y**	**N**	**N/A**	**14. Fever**	**Y**	**N**	N/A
a. Recorded for how long	Y	N		a. Recorded for how long?	Y	N	
b. Recorded about blood in the stool?	Y	N		b. Recorded stiff neck	Y	N	N/A
c. Recorded how much and what fluids mother has given *Assessment of general condition:*	Y	N		c. Recorded bulging fontanelle	Y	N	N/A
d. Recorded for sunken eyes	Y	N					
e. Recorded drinking	Y	N					
f. Recorded pinched skin on the abdomen?	Y	N					

15. Ear problem	**Y**	**N**	**N/A**				
a. Recorded about ear pain?	Y	N		d. Recorded pus draining from the ear	Y	N	N/A
b. Recorded if it woke the child at night?	Y	N		e. Recorded tender swelling behind the ear?	Y	N	N/A
c. Recorded ear discharge?	Y	N	N/A				

16. The health worker's examination findings or classification will be recorded as well as the researcher's classification below

(say if the section is not applicable)

	Nurse classification (tick relevant diagnosis)	**Researcher classification (tick relevant diagnosis)**
Those with cough and difficulty breathing	Not applicable Severe Pneumonia/very severe disease Pneumonia No pneumonia/cough/cold Other...	 Correct Incorrect Cannot determine/unsure Not applicable
Those with wheeze	Not applicable Recurrent wheeze (asthma) Wheeze first episode Other...	Correct Incorrect Cannot determine/unclear Not applicable
Those with diarrhoea	Not applicable Severe dehydration Some dehydration No dehydration Other... Severe persistent diarrhoea Persistent diarrhoea No persistent diarrhoea Severe dysentery Dysentery No dysentery	Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable
Those with fever	Not applicable Suspected Meningitis Fever other cause Other... Severe complicated measles Complicated measles Measles No measles	 Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable
Those with ear problems	Not applicable Mastoiditis Acute ear infection Chronic ear infection No ear infection Other ...	 Correct Incorrect Cannot determine/unclear Not applicable
All children	Severe malnutrition Not growing well Growing well Other ... Severe anaemia Anaemia No anaemia Other ...	Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable

	In those with HIV test: Confirmed HIV Possible HIV HIV negative Other ... *In those with no test:* Suspected symptomatic HIV HIV exposed HIV unlikely Other ... TB TB exposure Possible TB No TB	Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable Correct Incorrect Cannot determine/unclear Not applicable

17. Which of the following were administered by the health worker in the clinic? (tick what was done)

- First dose ceftriaxone IM
- First dose of cotrimoxazole
- Oxygen
- Nebulised adrenaline
- Prednisolone oral
- Salbutamol inhaled
- Fluids by IV or NGT
- ORS
- Vitamin A
- Diazepam PR
- Glucose (oral, NGT or IV)
- Other (please specify)

18. Complete the chart below for what was prescribed by the health worker (to take home)

Name	**Formulation**	**Dose**	**Frequency e.g. BD**	**Duration (days)**

19. Did the health worker record any explanation or demonstration how to administer oral treatment?

a.	Antibiotic	Y	N	N/A
b.	ORS	Y	N	N/A
c.	Other drugs	Y	N	N/A

20. Check to see if the first dose of the oral drug was administered at the facility and recorded

a.	Antibiotic	Y	N	N/A
b.	ORS	Y	N	N/A
c.	Other drugs	Y	N	N/A

21. Did the health worker record advice on feeding? Y N N/A

22. Did the health worker record safety netting advice? Y N

22a If YES, when did the health worker advise the caretaker to return? _____ **Days**

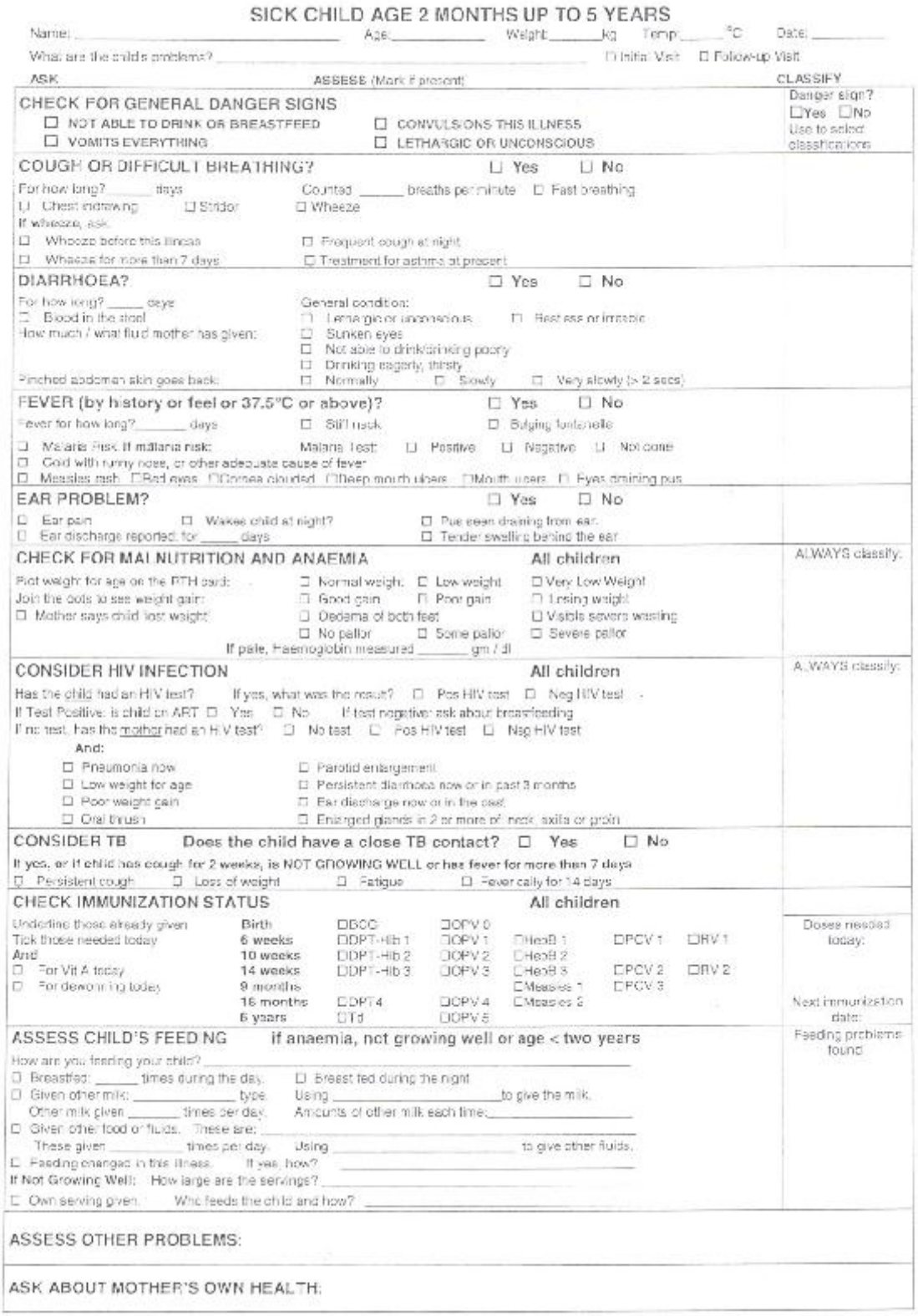
23. Did the health worker record when to bring the child back immediately for the following signs?
Tick all that apply

a.	Child is not able to drink or breastfeed	Y	N	N/A
b.	Child becomes sicker	Y	N	N/A
c.	Child develops a fever	Y	N	N/A
d.	Child develops fast breathing	Y	N	N/A
e.	Child develops difficult breathing	Y	N	N/A
f.	Child develops blood in the stool	Y	N	N/A
g.	Child drinking poorly	Y	N	N/A
h.	Other, specify _____	Y	N	

24. Did the health worker record the mother's health record her own health, access to family planning or vaccination status?

Y N

Appendix 10.4 Case Recording form



SICK CHILD AGE 2 MONTHS UP TO 5 YEARS

Name: _____ Age: _____ Weight: _____kg Temp: _____°C Date: _____

What are the child's problems? _____ ☐ Initial Visit ☐ Follow-up Visit

ASK | ASSESS (Mark if present) | CLASSIFY

CHECK FOR GENERAL DANGER SIGNS — Danger sign? ☐Yes ☐No Use to select classifications

☐ NOT ABLE TO DRINK OR BREASTFEED ☐ CONVULSIONS THIS ILLNESS
☐ VOMITS EVERYTHING ☐ LETHARGIC OR UNCONSCIOUS

COUGH OR DIFFICULT BREATHING? ☐ Yes ☐ No

For how long? _____ days Counted _____ breaths per minute ☐ Fast breathing
☐ Chest indrawing ☐ Stridor ☐ Wheeze
If wheeze, ask:
☐ Wheeze before this illness ☐ Frequent cough at night
☐ Wheeze for more than 7 days ☐ Treatment for asthma at present

DIARRHOEA? ☐ Yes ☐ No

For how long? _____ days General condition:
☐ Blood in the stool ☐ Lethargic or unconscious ☐ Restless or irritable
How much / what fluid mother has given: ☐ Sunken eyes
☐ Not able to drink/drinking poorly
☐ Drinking eagerly, thirsty
Pinched abdomen skin goes back: ☐ Normally ☐ Slowly ☐ Very slowly (> 2 secs)

FEVER (by history or feel or 37.5°C or above)? ☐ Yes ☐ No

Fever for how long? _____ days ☐ Stiff neck ☐ Bulging fontanelle
☐ Malaria Risk If malaria risk: Malaria Test: ☐ Positive ☐ Negative ☐ Not done
☐ Cold with runny nose, or other adequate cause of fever
☐ Measles rash ☐Red eyes ☐Cornea clouded ☐Deep mouth ulcers ☐Mouth ulcers ☐ Eyes draining pus

EAR PROBLEM? ☐ Yes ☐ No

☐ Ear pain ☐ Wakes child at night? ☐ Pus seen draining from ear
☐ Ear discharge reported for _____ days ☐ Tender swelling behind the ear

CHECK FOR MAL NUTRITION AND ANAEMIA — All children — ALWAYS classify:

Plot weight for age on the RTH card: ☐ Normal weight ☐ Low weight ☐ Very Low Weight
Join the dots to see weight gain: ☐ Good gain ☐ Poor gain ☐ Losing weight
☐ Mother says child lost weight ☐ Oedema of both feet ☐ Visible severe wasting
☐ No pallor ☐ Some pallor ☐ Severe pallor
If pale, Haemoglobin measured _____ gm / dl

CONSIDER HIV INFECTION — All children — ALWAYS classify:

Has the child had an HIV test? If yes, what was the result? ☐ Pos HIV test ☐ Neg HIV test
If Test Positive: is child on ART ☐ Yes ☐ No If test negative: ask about breastfeeding
If no test: has the mother had an HIV test? ☐ No test ☐ Pos HIV test ☐ Neg HIV test
And:
☐ Pneumonia now ☐ Parotid enlargement
☐ Low weight for age ☐ Persistent diarrhoea now or in past 3 months
☐ Poor weight gain ☐ Ear discharge now or in the past
☐ Oral thrush ☐ Enlarged glands in 2 or more of: neck, axilla or groin

CONSIDER TB Does the child have a close TB contact? ☐ Yes ☐ No

If yes, or if child has cough for 2 weeks, is NOT GROWING WELL or has fever for more than 7 days
☐ Persistent cough ☐ Loss of weight ☐ Fatigue ☐ Fever daily for 14 days

CHECK IMMUNIZATION STATUS — All children — Doses needed today: — Next immunization date:

Underline those already given
Tick those needed today
And
☐ For Vit A today
☐ For deworming today

Birth	☐BCG	☐OPV 0				
6 weeks	☐DPT-Hib 1	☐OPV 1	☐HepB 1	☐PCV 1	☐RV 1	
10 weeks	☐DPT-Hib 2	☐OPV 2	☐HepB 2			
14 weeks	☐DPT-Hib 3	☐OPV 3	☐HepB 3	☐PCV 2	☐RV 2	
9 months			☐Measles 1	☐PCV 3		
18 months	☐DPT 4	☐OPV 4	☐Measles 2			
5 years	☐Td	☐OPV 5				

ASSESS CHILD'S FEEDING if anaemia, not growing well or age < two years — Feeding problems found

How are you feeding your child? _____
☐ Breastfed: _____ times during the day ☐ Breast fed during the night
☐ Given other milk: _____ type Using _____ to give the milk
Other milk given _____ times per day Amounts of other milk each time: _____
☐ Given other food or fluids. These are: _____
These given _____ times per day Using _____ to give other fluids
☐ Feeding changed in this illness If yes, how? _____
If Not Growing Well: How large are the servings? _____
☐ Own serving given Who feeds the child and how? _____

ASSESS OTHER PROBLEMS:

ASK ABOUT MOTHER'S OWN HEALTH:

Appendix 10.5 Interview guide

INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS IN PRIMARY CARE

INTERVIEW STRUCTURE

Dear Colleague

I have indicated to you that I am busy with a project on the Integrated Management of Childhood Illness (IMCI) guidelines which forms part of a Masters Research project.

The aim of this interview is to obtain your ideas, experiences and opinions regarding the use of the IMCI guidelines. The information obtained will only be used for research purposes and will remain confidential and your anonymity will remain protected at all times. Do you have any questions before we start the interview?

May I audio-record the interview, as it would help me to listen to it again later and to make a transcript of the interview for data analysis purposes?

1. How do you feel about using the automated IMCI guidelines?
    a. Do you feel that you will be able to use the automated guidelines consistently every day?
    b. Were the questions clear?
    c. Was there any consultation where you disagreed with the classification and management of the patient?
    d. How did it work when the child had something that the system did not cover?
    e. Did the flow seem natural?
    f. Was it ever a problem having to ask questions in a certain order?
    g. Was there anything in the system that surprised you?
2. What problems have you experienced using the automated guidelines?
3. Was the automated guideline useful in your primary care setting?
    a. Do you think that the IMCI guidelines improve quality of care?
4. What role can the automated guidelines play in teaching and learning within your place of work?
5. What difference do you think the automated guidelines will make to your practice?

I would now like to ask you about the features you used?

1. Did you try the handwriting recognition? How was it for you?
2. How did you find using the keyboard?
3. What orientation did you use it in most when seeing actual patients? or when training? (e.g. landscape or portrait) And why did you prefer that specific orientation?
4. Was the computer set up so that the application came up automatically when you turned the computer on? If not, was this a problem for you?
5. How did you find the touch screen?

Is there anything else you would like to mention?